Quarterly Public Report

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Prepared for:	United States Department of Transportation Pipeline and Hazardous Materials Safety Administration Office of Pipeline Safety
Project Title:	"Consolidated Research and Development Program to Assess the Structural Significance of Pipeline Corrosion"
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Introduction

Metal loss due to localized corrosion and pitting of pipelines can significantly increase the risk of rupture. Therefore, it is vitally important to accurately determine the residual strength of corroded pipelines so that proper remedial actions may be taken to avoid catastrophic events. Although historical methods and practices for inspection and integrity assessment have led to an overall safe and reliable pipeline infrastructure with a low frequency of failures, public expectations concerning pipeline safety are growing, and industry is committed to pursuing further improvements. Consequently, new US regulations and sophisticated inspection technologies have burdened many operators with large quantities of data that are often difficult to interpret and apply within the framework of existing assessment guidelines. Clearly, the industry needs a technically sound, comprehensive and integrated approach to assess and mitigate the effects of localized corrosion in gas and oil pipelines, and to assure appropriate pressure-containment safety margins.

Several methods have been developed for assessment of corrosion defects, such as ASME B31G, RSTRENG and LPC. These methods were developed using an early fracture mechanics relationship for toughness-independent failure of pressurized pipes and were empirically calibrated against a database of full-scale burst tests for thin wall pipes. Some work has already been done to address the limitations of existing assessment methods available to the industry. The objective of this project is to establish the potential for fatigue failure from corrosion.

Summary of Progress – Project 153K

A full-scale fatigue test program has been developed on the basis of the literature review and finite element (FE) studies already undertaken. Four defects have been machined into the pipe wall to represent corrosion defects as follows:

Defect 1: groove, d/t=20%, L=400 mm, r=8.5mm (W=10.1 mm)*

Defect 2: groove, d/t=40%, L=400 mm, r=8.5mm (W=13.5 mm)*

Defect 3: groove, d/t=60%, L=400 mm, r=8.5mm (W=15.5 mm)*

Defect 4: patch, d/t=60%, L=400 mm, r=8.5mm (W=140 mm)

The results of the FE analyses and full scale tests have been collated and a new method for assessing corrosion in pipelines subjected to cyclic pressure loading has been developed.

Results and Conclusions

Defects 2, 3 and 4 all failed. Defect 1 did not fail after 1,2463,60 cycles and the test was terminated. The results are summarized in the table below. Non-destructive examination of Defect 1 did not show any indications of cracking. Metallurgical examination of the fracture faces of the three failed defects has shown no pre-existing defects; all failures were consistent with a fatigue mechanism.

Max pressure barg	Pressure range bar	No of Cycles (per stage)	No of cycles (cumulative) (2)	Comment
33.3	23.3	98,501		See note (1)
39.9	31.4	229,071	328,022	FAILURE of Defect 3
52.2	43.7	447,344	775,366	FAILURE of Defect 2
62.9	54.4	100,575	875,941	FAILURE of Defect 4
94.3	85.8	370,419	1,2463,60	Test terminated without failure of Defect 1

Note: (1) Maximum pressure gives ligament hoop stress equal to the materials specified minimum yield strength.
(2) The cumulative cycle count requires correction to allow for the effects of different pressure ranges. This correction will be carried out during preparation of the final report.

Payable Milestones

Payable milestones completed during this reporting period include:

- Literature Review Complete – Task Number 6
- Fourth Quarterly Status Report Submitted – Task Number 4